Southern Forest Experiment Station

SO-246

Research Note

1979

YELLOW-POPLAR ROOTING HABITS

JOHN K. FRANCIS

SUMMARY

Although the configuration of pole-sized yellow-poplar root systems in Tennessee is quite variable, a branched taproot with several widely spreading laterals is typical. Rooting depth is particularly limited by clayey texture, wetness, and firmness of subsoils.

Additional keywords: *Liriodendron tulipifera* L., taproot, water table.

YELLOW-POPLAR ROOT SYSTEMS

The rooting habits of yellow-poplar *(Liriodendron tulipifera* L.) are not well known. Toumay (1929) described yellow-poplar seedlings as having rapidly growing, deeply penetrating taproots with wide-spreading lateral roots. Steinbeck and Kormanik (1968) observed that in sandy strata, roots of yellow-poplar seedlings were round, fleshy, and easily separated from the soil. When roots grew into clay lenses, they became flattened, somewhat flaccid, and more likely to cling to fine soil particles. Coile (1937) found that nearly all roots in a mixed yellow-poplar and sweetgum stand were in the upper 19 inches of the soil. Despite these observations, we lack a clear idea of the structure of yellow-poplar root systems and how they are affected by soil properties.

I have documented the rooting habits of 10 pole-sized yellow-poplars and tried to relate root development to soil properties.

METHODS

Ten soils in middle Tennessee were chosen for their widely varying chemical and physical properties, topographic setting, and parent material. On each soil a dominant or codominant yellow-poplar about 4 inches in diameter was selected for study. Trees chosen varied in age from 8 to 34.

After each tree was cut, a trench was dug up and down slope with one face about 6 inches from the stump. Trenches were long enough to expose most of the root extension and as deep as the deepest yellow-poplar roots. A full description was made of each profile. Laboratory analysis of the chemical and physical properties of each horizon was performed.

The soil was carefully picked away from the roots of the tree until the trench face had been advanced 16 inches. After a 12-inch string grid was installed, the root system was sketched and photographed.

RESULTS AND APPLICATION

Yellow-poplar root systems were quite variable. Root size appeared to be governed by tree size, not age. Although roots grew in response to soil horizon conditions, much of the configuration of each yellow-poplar root system seemed to be a meandering response to soil pores and structure. Both deep and shallow root systems were present, but no sample

Southern Forest Experiment Station/T-10210 US. Postal Services Bldg., 701 Loyola Avenue, New Orleans, La. 70113
Forest Service, U.S. Department of Agriculture.
Serving Alabama, Arkansas, Louisiana, Mississippi, Eastern Oklahoma, Tennessee, Eastern Texas.

trees had abundant "feeder" roots at the interface between the forest floor and mineral soil as do many other forest species. The lack of abundant "feeder roots" makes yellow-poplar less likely than many of its associates to be weakened by disturbance of the forest floor by logging or cultivation.

Taproot and heartroot systems both occurred, but a several-branched taproot was more common (fig. 1). Lateral roots tended to grow parallel to the soil surface, whether sloping or flat; taproots and sinker roots grew down. The taproot or its branches extended much deeper into firm or wet subsoils than descending branches of lateral roots.

Roots in coarse-textured soil were round, long, little-branched, and fibrous. In clayey soil, roots were weak, fleshy, flattened, and more crooked and branched than in coarse soils. Clayey, wet subsoils caused dieback and subsequent branching of root tips (fig. 2). Dieback may have been caused by anoxia. The importance of good aeration to yellow-poplar roots, especially lateral roots, is illustrated in figure 3. After being buried by sandy alluvium, lateral roots of this yellow-poplar grew to near-surface positions and then spread out. However, the roots of some yellow-poplars can grow for a short distance into both seasonal and permanent water tables (fig. 4).

In shallow soils, yellow-poplars sometimes expanded their root systems laterally to make up for lack of rooting depth. Roots penetrated fragipans and other firm subsoils to a limited extent, but root growth was clearly reduced. Managers should avoid planting yellow-poplarwhere soils are wet and shallow, where water tables are high, or where fragipans or very firm subsoils exist.

Gravel in the soil did not alter root configuration and did not noticeably contort individual roots. Yellow-poplar can do well in skeletal soils, if soil depth is ample and the soil matrix is not hard. Old root channels were heavily used and may be important to root extension in dense soils. Where possible, plant near old stumps.

Although no changes were noted in rooting patterns, yellow-poplar generally did well where Ca and base saturation were high. Poor growth was observed where exchangeable Al was high and both Ca and base saturation were low. This pattern has been reported in many other species (Foy 1974).

For growing yellow-poplar, a manager should select a soil with no restriction to deep rooting, a soil able to supply ample moisture while being well aerated and containing abundant Ca and other basic cations.

Figure 1.—*Excavated root system of a yellow-poplar on Linker soil with typical root habit.*

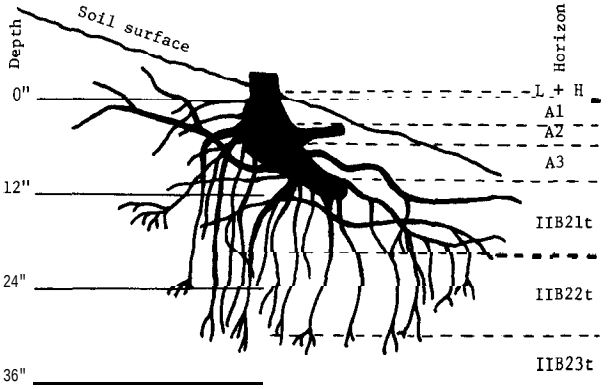

Figure 2.—*Excavated root system of a yellow-poplar on Swain soil showing root tips which have died back and branched.*

This research was done by John K. Francis at the Sewanee Silvicultural Laboratory, maintained at Sewanee, Tennessee, by the Southern Forest Experiment Station. Francis is now Associate Soil Scientist at the Southern Hardwoods Laboratory, which is maintained at Stoneville, Mississippi, by the Southern Forest Experiment Station, Forest Service — USDA, in cooperation with the Mississippi Agricultural and Forestry Experiment Station and the Southern Hardwood Forest Research Group.

LITERATURE CITED

Coile, T. W.
1937. Distribution of forest tree roots in North Carolina Piedmont soils. J. For. 35:247-257.

Foy, C. D.
1974. Effects of aluminum on plant growth. *In* R. W. Carson, ed. The plant root and its environment, p. 601-642. Univ. Press of Virginia, Charlottesville.

Steinbeck, K., and P. P. Kormanik.
1968. First-year root system development of two clones of yellow-poplar. Ga. For. Res. Counc. Pap. 55.

Toumay, J. W.
1929. Initial root habits in American trees and its bearing in regeneration. Int. Cong. Plant Sci. Proc. 1: 713-728.

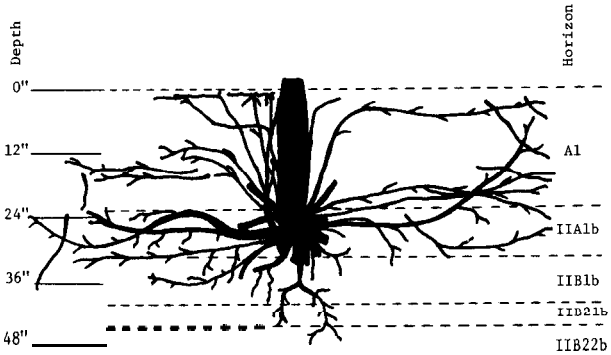

Figure 3.—*Excavated root system of a yellow-poplar on an unnamed soil. After burial, lateral roots have grown to shallower, better aerated positions.*

Figure 4.—*Excavated root system of a yellow-poplar on Guthrie soil. The taproot and sinker roots have extended more than a foot below the water table.*

U.S. GOVERNMENT PRINTING OFFICE 672-802 1979